

THE VARIOUS TYPES OF PLAGUE AND THEIR CLINICAL MANIFESTATIONS.¹

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THE invasion of the human organism by *Bacillus pestis* manifests itself in certain well-defined and clinically recognizable forms. Their development is determined solely by the path of entrance of the virus into the system: (a) If the infection takes place through the skin, by the bite of a rat-flea, or any other agency, and is conveyed into the lymph glands by the lymph stream, the *bubonic* type is the result; (b) if, under identical conditions, the infection becomes localized in the skin and subcutaneous cellular tissue, with or without secondary involvement of the lymph glands, the *cellulocutaneous* type ensues; (c) if, again under the same circumstances, the blood stream becomes directly infected, the *septicemic* type develops; and (d) if the lung-tissue becomes primarily infected, through inhalation or other causes via the air passages, the *pneumonic* type ensues.

Four clinical types are, thus, capable of differentiation at the bedside, each having special characteristics of its own, and each with an important bearing upon the prognosis. The almost classical and synonymous association of the word buboes—*emerods* in Biblical language—with plague, absorbed the whole attention of the observers to the exclusion of the other types, when the disease first broke out at Bombay. Clinical observation, however, soon revealed the presence, as Childe² was able to demonstrate, of a few cases of the pneumonic type in 1897. Subsequently the septicemic type was encountered and described by several observers, including myself; and finally, after careful study of a number of cases, extending over three epidemics, I was enabled to verify and describe the cellulocutaneous type in 1900.³

All these types do not prevail to the same extent. Hospital experience at the Arthur Road and Maratha Hospitals at Bombay,⁴ throughout twelve epidemics comprising over 13,600 cases, shows that the *bubonic* type contributes 92.8 per cent. of all cases; the *cellulocutaneous* type, 3.7 per cent.; the *septicemic* type, 2.4 per

¹ Read by title at the sixth annual meeting of the American Society of Tropical Medicine, Washington, D. C., April 10, 1909.

² Transactions of the Medical and Physical Society of Bombay, 1897.

³ Some Observations on Plague and its Treatment with Lustig's Serum, Transactions of the Medical and Physical Society of Bombay, 1900.

⁴ N. H. Choksy. An address on the General Pathology and Serum Treatment of Plague, 1908.

cent.; the *pneumonic* type⁶ 1.0 per cent.; and *pestis ambulans*, 0.1 per cent. These ratios, however, are not constant even for all of India; and in other parts of the world many variations have been recorded. At Hongkong, for instance, Koch⁶ has reported the following incidence: The bubonic type, 63.6 per cent.; the septicemic type, 31.4 per cent.; and the pneumonic type, 5 per cent., in 510 patients observed during 1904.

I. THE BUBONIC TYPE. Within three days after infection and usually without any prodromes,⁷ the patient becomes suddenly ill, sometimes in the midst of his work, has a rigor, feels giddy, and may even fall in the act of walking. The temperature begins to rise almost immediately and simultaneously with it, pain and tenderness in the infected glands are complained of. Such glands may be situated in different parts of the body, the order of frequency being the femoral, inguinal, and iliac glands, separately but more often in continuation, the axillary, and the brachial chain with the epitrochlear, the cervical, parotid, and submaxillary glands, and but rarely those in other positions, such as the femoral chain, the popliteal, in the calf, at the ankle, at the bend of the elbow, pre-auricular, or even occipital. The eyes become suffused, the mind somewhat dull, the speech faltering, and the expression either apathetic or anxious and frightened. The patient is generally averse to acknowledge that he is at all ill, and often refuses to take to his bed. Even if convinced that he is afflicted with plague—for there exist but few who do not realize it—he persists in ascribing his symptoms to a chill or exposure, and the swelling and pain in the bubo to a sudden strain and more often to the initial fall. On the other hand, it often happens that the patient not only apparently deludes himself, but succeeds in deceiving those around him, by denying the presence of pain or tenderness in the bubo, and if the medical attendant is not confident or resolute in his diagnosis, he shares the same fate, to the ultimate ruin of the patient. As the temperature rises, the pulse becomes quickened, usually out of all proportion to the normal ratio, is found to be of low tension and easily compressible, even within a few hours. There may be nausea or vomiting, mostly of bile, and by the evening the temperature becomes elevated to 104° to 105°; there is restlessness and insomnia, if not actual delirium. Pain and swelling in the bubo are more noticeable, and periglandular oedema may appear. The patient thus presents within a few hours all the cardinal symptoms of plague.

⁶ Major G. Lamb, I.M.S. The Etiology and Epidemiology of Plague: A Summary of the Work of the Plague Commission, 1908. The Plague Research Commission states that the proportion is about 2.5 per cent., and that is probably correct, inasmuch as many cases go unrecognised and others succumb at home.

⁷ Colonial Medical Report for Hong Kong for the Year 1904, Journal of Tropical Medicine, August 1, 1905.

⁸ No local lesion is noticeable at the seat of infection except among 8 to 10 per cent. of cases.

The following morning a slight remission in the temperature may or may not be observed, but without any amelioration; all the symptoms, general and local, become more intensified; the tongue is now dry and presents the characteristic appearance of wash leather, but with a red tip and margins; the weakness of the circulation is more pronounced, and the extremities are cold. The patient does not like to be disturbed out of the position he may have assumed, resents all or any interference, is obstinate, and refuses nourishment and medicines; there is extreme irritability, coupled with greater dulness of the mental faculties; the speech is thicker, the syllables being drawn out, or there may be aphasia; delirium may exist; and the temperature rises to the same or even a higher range than the first day. After a restless night and the lapse of forty-eight hours, there appears a distinct and perceptible remission in the temperature, varying from 1° to 4° or more, with or without apparent amelioration. If the former, it is extremely deceptive and of short duration, inasmuch as within a few hours there is a complete change for the worse in every respect. The usual course however, is for the remission to be unaccompanied by any temporary improvement. As all the symptoms become more and more aggravated, the buboes are larger and more prominent, the local oedema greatly increased, the pulse feebler. By evening the temperature again becomes elevated to the same or even a higher level than on the previous days. With these symptoms the patient may be said to enter the most critical phase of the disease, inasmuch as the following two days decide his fate—the average duration of fatal cases being but five and one-half days. Here we are practically at the parting of the ways the future depending upon two factors: (1) It depends upon the extent of the cardiovascular paresis, as also upon the acute infective degeneration of the myocardium brought about by the toxemia. These lead to sudden cardiac syncope or gradual enfeeblement of the circulation, with eventual heart failure, preceded by a slowly progressive oedema of the lungs, owing to the vicious circle set up between the circulatory and the respiratory apparatus. Should this occur, death usually takes place between the third and fifth days of illness. Fully 82 per cent. of all deaths among these cases occur within this period, and 18 per cent. thereafter. The average rate of recovery among them is about 55 per cent. (2) It depends upon the presence of septicemia, for it is about this period, that is, the third day—though in a few cases even earlier—that this primary dominant factor in plague shows itself. Instead of the infection remaining strictly localized within the lymphatic system, it becomes generalized through infection of the blood stream, owing to numerous direct communications that naturally exist between the lymph channels, on the one hand, and arteries and veins on the other, in the axilla, the side of the thorax, in the groin and other situations where buboes mostly predominate. In the case of deep abdominal

buboes the veins become adherent to them, and thus direct infection of the blood is brought about. Once *Bacillus pestis* gains entrance into the circulation, it multiplies enormously, and rapidly becomes distributed throughout the internal organs, notably in the spleen and the liver. Masses of bacilli cause embolic infarcts in the organs, besides inducing terminal pneumonia. And as disintegration goes on simultaneously with multiplication, the liberated endotoxin simply floods the tissues, produces necrotic degeneration of the organs, and sets up hemorrhages from almost all hollow and solid viscera; profound changes in the finer elements of the nervous system occur from the toxin combining with the tissue cells, disorganizing their functions and laying in train the seeds of future mischief, the effects of which time and patience alone can eradicate.

The septicemia is generally of a progressive type, being most intense just prior to death; the number of organisms present in the blood may vary from 10 to 1,000,000 per cubic centimeter, and the growth of colonies on sloped agar from 0.1 c.c. of the blood may be few, fairly numerous, numerous, or very numerous, as classified by the Plague Research Commission.*

The development of septicemia can only be positively confirmed by bacteriological examination of the blood by culture, as the microscope fails to give any positive indication except in about 17 per cent. of such cases. The clinical signs, however, in about 72 per cent. of these cases raise a strong presumption of its presence; these consist in a quick, thready, compressible or almost imperceptible pulse, accompanied by intense nervous prostration, jaundice, and rapid wasting of the muscular and adipose tissues of the face, the features becoming pinched and hollowed out, even in the course of a single night, together with hemorrhages from the stomach, kidneys, or intestines. *Per contra*, the condition of the patient in about 28 per cent. of such cases, even in spite of a profound septicemia, is apparently so favourable that the physician is often deceived; the prognosis suddenly and, indeed, without any warning becomes falsified within a few hours, as death takes place by rapid cardiac failure. About 85.5 per cent. of all deaths among septicemic cases occur within six to seven days of illness, and 14.5 per cent. thereafter. The average recovery rate among them varies from 3 to 4 per cent. only, as compared with 55 per cent. among the non-septicemic.

If the ultimate fate of the patient is to be decided by the first factor—cardiac failure through toxemia—his general condition becomes gradually worse after the evening of the third day, the temperature oscillates until death between 102° to 104°, the delirium becomes fierce or maniacal, requiring physical restraint; he refuses

* Journal of Hygiene, Extra No. 1 and 4, being Reports on Plague Investigations in India, September, 1906, and May, 1908.

medicines and nourishment, and each act of struggle or restlessness adds to the efforts of the greatly embarrassed heart; until it eventually ceases to beat, the patient sometimes expiring in the course of or immediately after a violent attempt at exertion, engendered presumably through deficient oxygenation or air-hunger. On the other hand, if a septicemia is to be the determining factor, the struggle between its steady, onward progress and the defensive processes of the system is no less arduous or prolonged. The clinical features above described supervene, the temperature, however, affording no clue; terminal pneumonia, internal and external hemorrhages, a semicomatose condition or actual coma, end the scene within the first week. Whenever a septicemia is limited in extent or is controlled by the action of the antipest serum, and the life of the patient thus prolonged, he drifts into marasmus, which I have described fully in a paper read at the Bombay Medical Congress of 1909.*

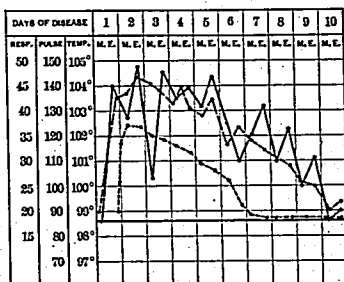


FIG. 1.—Chart of a normal case of plague of the bubonic type. (Solid line = temperature; dash line = pulse; dotted line = respiration. Same device in the other charts.)

If the patient is to recover, the further progress of the case is demonstrated by the accompanying chart (Fig. 1). After the lapse of forty-eight to sixty hours or longer since the evening of the third day, that is, by the sixth or seventh day, a gradual but perceptible change for the better becomes evident. The temperature slowly declines, there is amelioration in the general condition, the pulse improves in volume and tension, and the bubo or buboes become more circumscribed and prominent from commencing necrosis and suppuration. The pyrexia terminates by lysis, by short elevations and remissions, until it reaches normal on the morning of the ninth

* N. H. Choksy. On the Clinical Significance of Septicemia in Human Plague, Bombay Medical Congress, 1909.

or tenth day, the tongue gradually clears, the appetite returns, the patient's appearance is brighter, and a very hopeful sign—he commences to grumble about something or other, or everything imaginable. Should the buboes suppurate, incision is required. The curve of temperature in a normal and uncomplicated case is thus limited to about ten days; occasionally it is shorter, but never less than eight days. It is usually divisible into three curves, the first terminating on the morning of the third day, the second on that of the sixth or seventh, and the third on or about the tenth day. This indicates that the disease is self-limited and bound to run a definite course, and that no abortive treatment can possibly deflect or modify its course except the early and liberal use of the antipest serum. Variations in the above curve are numerous: there may be but two only, or they may merge into each other; and, besides, complications, deep-seated buboes or their extension, or a succession of buboes in different positions, each ushered in by a well-marked elevation—all these render the curve unrecognizable except to an expert.

II. THE CELLULOCUTANEOUS TYPE. The development of the cellulocutaneous type is dependent upon the peculiar property of *Bacillus pestis* whereby its protoplasm or endotoxin is capable of setting up inflammatory and retrogressive changes of tissue elements, leading to progressive local necrosis. Klein¹⁰ says, in reference to other organisms (but equally applicable to the bacillus plague), that the necrosis following typical symptoms of inflammation is the result of the local action of the bacilli, and so long as they are in sufficient numbers and of sufficient virulence, and so long as their multiplication proceeds, the necrosis of the tissues spreads into larger and larger areas. That is well exemplified in the case of the large necrosis often observed in plague.

Definite lesions at the point of infection exist in about 8 to 10 per cent. of cases, consisting in the development of phlyctenules, pustules, bullæ, and umbilicated bullæ. It is from the latter that this type originates. If the bulla is cut open or bursts of itself and the central core is removed, its point of attachment to the base appears as a small dark spot. It gradually increases in size until the whole of its base is encroached upon, and obliterated by a dark eschar. This continues to spread at the circumference from day to day until a period is reached when the medium suitable for the further multiplication of *Bacillus pestis* becoming exhausted, a line of demarcation appears. The eschar assumes a dark greenish hue, feels cold to the touch, is almost hard and leathery, and depressed in the centre, as if firmly bound down to the tissues underneath. Its spreading margin, somewhat higher, is conterminous with the surrounding skin, which becomes converted into a hard, angry, in-

¹⁰ Brit. Med. Jour., August 4, 1900.

flamed areola studded with minute vesicles; and often small, secondary necrosis is noticeable at some distance from the periphery through infection from the parent necrosis when it happens to be extensive. Multiple umbilicated bullæ are also occasionally met with on different parts of the body surface, each giving rise to a small necrosis. If a little fluid be examined from the margin, it invariably shows a pure culture of *Bacillus pestis*. The destructive process, if limited, becomes a comparatively benign form of plague, to which I have applied the term "Cellulocutaneous Plague."¹¹ The buboes, if present—they are not invariably so—are secondary; and although, owing to the slowness of the process, the course of the disease is prolonged from two to three weeks instead of the normal period of eight to ten days, the recovery rate is higher. It is probable that recovery is determined, as Pescarolo and Quadroni¹² say in relation to Eberth's bacillus in typhoid fever, by the behavior of *Bacillus pestis* in the tissues in relation to the processes of infection and immunization, which differs, as we have already seen, from what it is when confined to the circulation; and in its conflict with the cellular elements of the tissues, immunizing bodies are produced which bring the infective process to a rapid termination. Should the necrosis become extensive, as in some cases it does, involving as much as sixty to ninety square inches of the body surface, the infection becomes generalized and the patient succumbs through septicemia.¹³ Once the line of demarcation has formed, it is not difficult to remove the entire slough en masse, leaving behind a saucer-shaped depression in the subcutaneous tissue (often exposing the deep fascia and muscles) of gradually increasing depth from the periphery to the centre, filled with shreds of necrosed tissue, pus, and blood; it gradually assumes a healthy aspect under appropriate treatment. Such necroses have been observed on the scalp, neck, face, back, chest, arm and forearm, the abdominal wall, lumbar and gluteal regions, over the mammary gland, the vulva, and on the scrotum, the thigh, leg, and foot; in fact, wherever such umbilicated blisters might be situated. The destruction of the soft tissues is often enormous, and large cavernous cavities exposing the bones of the face and head, involving exfoliation of the periosteum, and so also the cartilages of the ear, the eyelids, and the nasal bones. The upper and the lower jaws may be exposed when the process is confined to the head, neck, and face; the ribs may become exposed on the side of the thorax, and the testes if the scrotum is involved.

The clinical features are confined mainly to the local manifestation, its progress being marked by a slow and steady advance from

¹¹ Otherwise called carbuncles, and hitherto assumed to be a complication of plague; also known as pest necrosis.

¹² *Zentralb. für inn. Med.*; *Brit. Med. Jour.* (Epitome No. 292), November 14, 1908.

¹³ It is also possible for septicemia to occur through the original bulla, before necrosis develops, as in Case No. 129, of 1908, at the Maratha Hospital.

day to day until the line of demarcation forms. The presence of buboes in direct lymphatic communication with the necrosis is dependent upon its extent. If the necrosis is small and less than a dollar in size, the buboes are more pronounced and the clinical phenomena almost identical with those observed in the bubonic type. Should it be larger—four to six inches in diameter—the buboes are of subordinate significance, inasmuch as the invasion being strictly localized, the general disturbance of the system is not so great and the result favorable. When the primary necrosis is at all extensive and oversteps the above limit, there are more chances of a septicemia developing, or, again, the patient may succumb through secondary infection or prostration, even after its excision.¹⁴ The recovery rate is about 36 per cent., as compared with 25 per cent. in the bubonic type, and thus it constitutes the most benign type of plague.

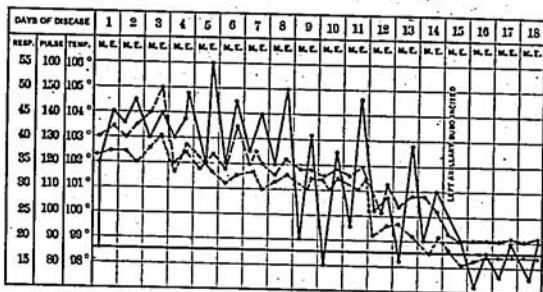


FIG. 2.—Chart of a normal case of plague of the cellulocutaneous type.

The accompanying chart (Fig. 2) illustrates the temperature curve of a case in which two necroses existed under the left costal margin, together with a bubo in the left axilla; the latter suppurred and was incised on the fifteenth day of illness. The course of the affection is seen to be prolonged to a fortnight, and the temperature curve is quite dissimilar to that in the bubonic type.

The accompanying photographs (Figs. 3 to 8) demonstrate the varying extent of the necrosis in different cases.

III. THE SEPTICEMIC TYPE. The septicemic type owes its origin to primary infection of the blood, *Bacillus pestis* gaining direct entrance into the circulation.¹⁵ The course of the affection is vari-

¹⁴ N. H. Choksy. *The Treatment of Plague with Prof. Lustig's Serum*, Bombay, 1903.

¹⁵ Malignant infection, with tiny deep-seated buboes and early septicemia, is liable to be mistaken for septicemic plague, the true nature of such cases being revealed only at the autopsy.

able, extending from five to ten days. As in secondary septicemia in the bubonic type, a certain proportion of cases do not exhibit



FIG. 3.—A small necrosis on the back in the lumbar region with secondary buboes in Scarpa's triangle; recovery.



FIG. 4.—A large necrosis involving the forehead and side of the face over the temporal, zygomatic, malar, and nasal regions, with destruction of the upper and lower eyelids; recovery.

any clinical signs of grave systemic infection; so also there exist similar cases in the primary infection, in which, beyond a persistent high temperature with short morning remissions and evening exacerbations and a weak and frequent pulse, there is total absence of all grave symptoms: no jaundice, no wasting, no prostration, no delirium

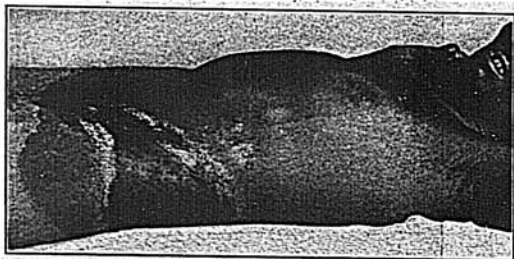


FIG. 5

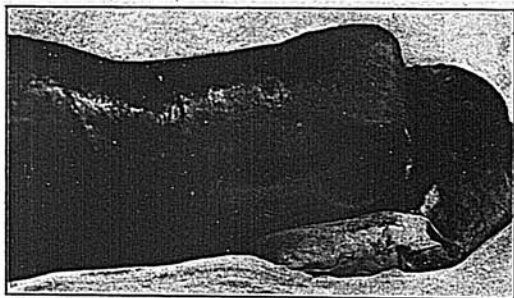


FIG. 6

FIGS. 5 and 6.—Front and back views of an extensive necrosis, extending from the fold of the groin to the iliac crest, over the hip, and to the lumbar region, with small secondary necroses; fatal.

the mental faculties perfectly clear, and to all intents and purposes nothing apparently serious to bespeak a fatal termination within three to six days. And yet, such is the way in which they invariably terminate. The only possible means of diagnosis is by culture of the blood, which is not often undertaken until too late, and by the time it becomes confirmed the patient has succumbed through cardiac failure.

The accompanying chart (Fig. 9) illustrates the course of such a case with all the above characteristics.



FIG. 7.—Secondary necrosis from the bubo infecting the subcutaneous cellular tissue in Scarpa's triangle; recovery.¹³



FIG. 8.—Wounds from two necroses, one on the scalp and the other on the side of the neck, in the process of cicatrisation.

¹³ Secondary necrosis from infection of the skin and subcutaneous cellular tissue by the bubo is occasionally met with, when the latter rapidly enlarges, comes up to the surface, and forms adhesions. It spreads similarly as the primary, and when the eschar is removed, the bubo is found to be firmly attached to its under surface.

By far the more common, however, is the type in which the symptoms are well pronounced at the very outset, the temperature usually following until the fourth day the ordinary course, as in the bubonic type, but variable thereafter. An extremely weak and thready pulse, intense and grave jaundice, profound nervous prostration, the limbs heavy and almost leaden, stupor or coma, the tongue brown, hemorrhages from the stomach, kidneys, or intestines, or subconjunctival, coldness of the extremities, and a few hours before death the appearance of one or more buboes in different parts of the body—such is the clinical picture exhibited. The only affection for which such cases are likely to be mistaken is grave spirillar infection in relapsing fever, but the absence of spirilla in the blood and the culture test confirmed the diagnosis. The following charts illustrate the course of such cases: Case No. 1721, of 1905 (Fig. 10), indicates the presence of severe melena causing

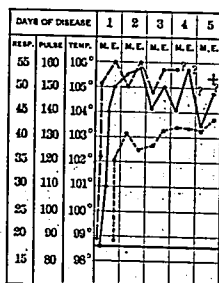


FIG. 9.—Chart of the septicemic type of plague.

collapse with subsequent reaction, and the development of femoral, inguinal, and iliac buboes on the morning of the day the patient succumbed. The other two cases, No. 838, of 1905 (Fig. 11), and No. 65, of 1904 (Fig. 12), show a somewhat more prolonged course, extending between nine to ten days, with the development of buboes on the seventh and ninth and tenth days respectively. In a few septicemia cases, however, the buboes appear on the third day of illness, the affection becomes partially localized within the lymphatic system, and recovery is just possible. But, on the whole, the fatality of these cases is so great that not more than 2 per cent. recover.

IV. The PNEUMONIC TYPE. The most insidious and virulent and at the same time highly infective is the pneumonic type. The infection is usually contracted by inhalation of the fine spray of the infective sputum teeming with the bacilli. It is just possible that

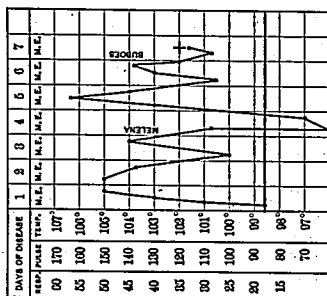


FIG. 10

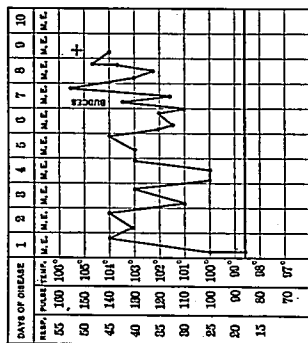


FIG. 11

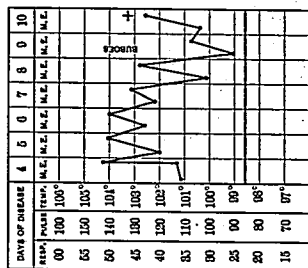


FIG. 12

FIGS. 10, 11, and 12—Charts of the septicemic type of plague to illustrate the presence of internal hemorrhage and the late development of buboes just before death

it may be conveyed by the infected finger to the pharynx or tonsils, where a focus is formed, whence the lungs become infected. Or, again, the apparent primary pneumonia may be not really so, but a secondary development of malignant infection with deep-seated buboes, not felt during life-time, and early septicemia. The clinical picture of the type is masked in the early stages, and does not exhibit its full development until late. The course varies from three to five days, the termination being invariably fatal (Fig. 13).

Moderate fever, neither the pulse nor the respiratory ratio correspondingly higher; no physical signs, and yet marked prostration and aspect of grave illness; then, within a few hours, some scanty pellets of hemorrhagic sputum, followed by death within twenty-four hours, characterize the disease. The apparent initial mildness rapidly assuming gravity even without the appearance of the char-

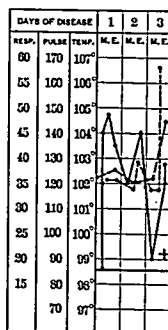


FIG. 13.—Chart of the pneumonic type of plague.

acteristic sputum is a peculiar feature of the type. The sputum may be thick, viscid, almost or even purely hemorrhagic or thin and mucoid, tinged bright red; it may be profuse or extremely scanty, and brought up at long intervals. Simple microscopic examination of the sputum is extremely deceptive for purposes of diagnosis, as other organisms simulating the morphological characters of *Bacillus pestis* are not of infrequent occurrence. Many cases so diagnosticated have eventually proved not to be pneumonic plague. It is, therefore, absolutely necessary to make a culture and inoculate animals with it or with the sputum. If the animal responds to the usual tests, and plague bacilli are recovered from it, then only can the diagnosis be positive.

The rarity of this type and its great infectivity claim special

notice. One single case is often the focus of a whole series of cases. The case of the late Major Manser, I.M.S., and his attending nurses; that of one of the former house surgeons of the Maratha Hospital, with its series of sixteen cases; that of one of the nurses at the Bai Motlabai Hospital, and of the student, both attending upon a case of the pneumonic type, who had miscarried, one and all terminating fatally, are sufficiently appalling. So far as regards Bombay. On the other side of India, Major Green and Dr. Justice¹⁷ have recorded the history of the Baker-gunge epidemic of pneumonic plague, in which one case originating at Calcutta, in the house of Kavi-raj Dwarkanath, led to a series of nineteen other cases, all of which proved fatal. Lieut.-Col. Crawford¹⁸ has recorded another similar outbreak, involving twenty persons at Hughli, in January, 1905. In all the above instances the infective agent was the sputum of the patient, which induced a similar affection among others. Under other circumstances, however, especially if it happens to fall upon an exposed and inflamed mucous surface like the conjunctiva, it gives rise to bubonic plague. The saddest case of the kind that has come under my observation was that of one of the English nurses, at the Arthur Road Hospital. She had a severe catarrh with injected conjunctiva at the time. While bending over a patient to feed him, he happened to cough, and a drop of the infected sputum fell into the eye; three days later she developed plague with preauricular, parotid, and cervical buboes, with infiltration on the side of the infected eye, and eventually succumbed from œdema of the glottis.

No recovery from pneumonic plague in which the diagnosis has been confirmed as above has been hitherto recorded in Bombay. I have seen none in the course of twelve epidemics. I am, however, able to report one instance in which there was double infection of the lungs by *Bacillus pestis* and *Bacillus pyocyaneus*. The patient was admitted on the third day of illness—July 1, 1907—with moderate fever, 101.8°; pulse, 101, of fair volume; and respirations, 30; no physical signs and no sputum to indicate the nature of the case, except marked prostration. On the night of the sixth day, however, the temperature rose to 104.4°, the pulse to 130 and respirations to 35, and he developed symptoms of pain, tightness and constriction in the chest, dyspnoea, and cough, with scanty sputum, the naked eye appearance of which was characteristic neither of pneumonic plague nor of croupous pneumonia. It appeared to be somewhat dark and rusty, with a layer of greenish mucus, almost purulent. Physical examination revealed isolated patches of dulness in the middle region on both sides. A culture of the sputum was then made and sent to Dr. Ghadially, the Municipal Analyst, who reported three

¹⁷ Report of the Indian Plague Commission, 1902, p. 91, par. 203.

¹⁸ Indian Med. Gaz., October, 1905.

days later the presence of *Bacillus pestis* and *Bacillus pyocyaneus* in the culture, a little scraping from which was inoculated subcutaneously into a white mouse, and it succumbed within forty-eight hours and plague bacilli were recovered from it. There was thus no room for doubt as to the nature of the case. The patient remained in a rather precarious condition for three days, but improved thereafter, the temperature, pulse, and respirations gradually became lower, and when the sputum, which had in the meantime altered its character, was reexamined on the eleventh idem, the thirteenth day of illness, there were no plague bacilli, but *Staphylococcus aureus* only; some of the culture from the sputum inoculated into a mouse did not kill it. In the meanwhile infection from the bronchial glands had spread to the deep abdominal and mesenteric glands, and pain, fixation of the abdominal wall, and tympanites developed, the course being subacute, without much rise of temperature after the seventeenth day of illness. Recovery, however, was gradual. In another instance there was double infection from *Bacillus pestis* and the pneumococcus, and it ended in recovery. Recovery is thus possible in cases of very moderate mixed infection.

V. THE AMBULATORY TYPE. The mild type of plague recognized as *Pestis ambulans* is characterized by moderate fever lasting for a few hours to a day or two, one or more small and tender glands, and hardly any constitutional disturbance. The patient may or may not rest; he usually works; and if the buboes get gradually absorbed, there is no other trouble. Occasionally suppuration takes place, whereupon he resorts to the hospital for relief.

Such, in brief, are the various types of plague and their principle clinical features as observed at Bombay. Whether the affection presents essential differences in its types and symptoms in different parts of the world owing to climatic, racial, or other causes, I must leave to others better qualified than myself to say. In so far as Bombay or Western India is concerned, those types prevail, but with a distinct racial incidence and fatality, depending to a great extent upon social conditions and environments. The greatest sufferers with the heaviest mortality rate (76.57 per cent.) are the Hindoos; the Mahomedans come next (68.52 per cent.), closely followed by the native Christians (65.80 per cent.); and lastly the Parsees (50 per cent.)¹⁹ Europeans and Eurasians suffer so little in comparison that their statistics are scarcely worth comparing. The racial incidence of attacks also presents corresponding differences.

¹⁹ These figures relate to the actual case mortality rate recorded among 136,000 patients treated at the Arthur Road and Maratha Plague Hospitals during the twelve epidemics.